AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 12, Vol. VI.
New Series. | JUNE 15, 1841. | Whole No. 384.
Vol. XII.

THE POST MASTER GENERAL VERSUS RAILROADS.

The Post Master General having passed some strictures upon railroads in his recent report, we shall, for the information of our readers, present them with his remarks and certain comments thereon.

"Notwithstanding the heavy increased expenditure consequent upon the act of 7th July, 1838, and although, instead of the supposed gradual increase of revenue, the receipts for the quarter ending 31st March last, present, as compared with the corresponding quarter of the year before, a diminution of more than *six* per cent., still the department would probably find sufficient relief in its future operations from the decrease of prices which, it may be calculated, will be hereafter demanded upon most of the routes, were it not for the continually increasing exactions in other branches of the service.

"To present this subject in its most intelligible form, the First Assistant Postmaster General has prepared a tabular view of recent proposals, that comparison may be made between the amount of present bids and the sums now paid for mail service upon the same routes. This table is hereto annexed, marked D.

"On an examination of this statement, it will be seen that, in some cases, the amount demanded by railroad companies for transportation of the mails is more *than two hundred per cent.* higher than is paid for coach service, upon roads forming connecting links between different railroad companies, upon the same main route, and that too, where the night service upon the railroads is less than that performed in coaches. Such demands deserve more consideration from the fact that, whilst at the recent lettings in New York and in the six Eastern States, the accepted service by coaches and other modes of conveyance has been secured at an average saving of *twenty-two* per cent. upon the contracts of 1837, there are but few instances where the demands of incorporated companies have not been increased in such manner as imposed upon me the necessity of

suspending the contracts. Nor is the extravagant price demanded for mail transportation upon railroads the only manner in which these incorporations affect the revenue of this department. The facilities secured by this mode of conveyance for sending letters by private hands, very seriously diminish the receipts of the offices upon these routes. A single illustration will establish this assertion.

"Boston is one of the most important points of railroad concentration in the Union. Its business prosperity is proverbial; and yet in that city, the quarter ending 31st March last, shows, as compared with the corresponding quarter of the year before, a decrease in postage receipts of *three thousand one hundred ninety-five dollars*—being double the amount of diminution to be found, within the same time, in any other post office in the nation, with the single exception of Philadelphia, which is another great *terminus* of railroad communication.

"These facts are presented in no spirit of unkindness towards those to whose management these incorporations are intrusted, but that I have considered it due to our whole people to refer to this subject, as one which will ere long call for National and State legislation, unless a corrective be sooner applied by public opinion."

The grounds of complaint against railroads are two in number, and these are so distinct in their nature, that we shall take them up separately.

In regard to "the extravagant price demanded for transportation upon railroads," the charge is founded upon a comparison between the charge of railroads and stages upon the same main route—"*and that too when the night service upon the railroad is less than that performed in coaches.*" We have in the Post Master General's own words, a proof that the subject is either imperfectly understood or unfairly expressed. It is certainly cheaper to run a stage coach, at night particularly, over a short route than to run a railroad train. In fact, this is the whole secret of the difficulty with railroad companies—the mail service, in most cases, requires them to start at inconvenient hours—viz. at such hours as do not suit the majority of the travelling community. Such companies are not disposed to go out of their usual course unless for an adequate remuneration; their business, particularly upon great routes, is very good, and they need no assistance; stage proprietors are, under the same character of routes, very well disposed to run an opposition to railroads, their passengers would be insufficient for a support, while a moderate compensation for mail service would be enough to pay a small profit, while without it, there would be none at all.

But throughout his report, the Post Master General has no reference to the superior speed of railroads, and the consequent increase in the facility of intercourse. Is it not worth paying even two

hundred per cent. more for the privilege of sending a letter from New York to Philadelphia and receiving an answer the same day, instead of writing one day and receiving the answer the next? And even this could not be accomplished in coaches without very great expense. This great oversight has brought out a number of anecdotes of the primitive mode of carrying the mail, which Mr. Granger seems to have had in mind when he made his tariff of charges. We have been told, that within fifty years, the great western mail from Albany was carried by a postman on foot, at what number of miles per hour we are not informed—when business increased the mail was carried on horseback, and soon, in a one horse wagon, and then passengers were taken. Such primitive methods of transport might probably be reintroduced with great saving to the Post Office department. We have seen a notice by Mr. Benjamin Franklin, informing the public that arrangements for facilitating the intercourse between Boston and Washington had been made, by which a letter might be written and an answer received in the short space of three weeks!! instead of six weeks as formerly!

There are cases, no doubt, in which exorbitant demands have been made; railroad companies are not immaculate, neither are stage proprietors, and on reference to former lettings it will be found that the words " too high," are marked opposite many bids for stage service.

The second complaint against railroads is quite as singular as the first. The Post Master tells us that "*the facilities secured by this mode of conveyance for sending letters by private hands very seriously diminish the receipts of the office upon these routes.*" We should like to know what the facilities are which enable passengers upon railroads to carry private letters more readily than when travelling in stages. The Post Master should have said that there was more travelling by this than any other conveyance, that between two cities, for important business, the expense of time was trifling, and that of money not to be compared to the advantage of attending in person to business of any consequence. He should have said, that as the expense of travelling decreases, postage remaining the same, there will be a constant diminution of the post office revenue upon such routes.

With equal justice might the Secretary of the Treasury complain of clergymen, that their influence diminished the revenue derived from the importation of indecent books and prints.

If the Post Master General wishes to keep up with the times, let him bring about a reduction in postage, and he will soon see that

such a course will answer far better than national or State legislation, to say nothing about the propriety of his appeal to public opinion.

For the American Railroad Journal and Mechanics' Magazine.

TOLLS ON CANALS AND RAILWAYS—LOW FARES.

I beg leave to call your attention to an article in the Civil Engineer and Architect's Journal of November, 1840, on Mr. Ellet's "Remarks on Railway and Canal Traffic," (published in this Journal some time since, in which the writer undertakes to show that the principles there advocated, are "fallacious and unjust," and to suggest the propriety of your publishing this article, either wholly or in part, as you may think proper. It is not my intention to offer any remarks or opinions on these objections to Mr. Ellet's theory, but, "while up," will take the opportunity of giving my views on the at present, very popular theory of low fares on railways.

This theory may be said to rest on the following proposition—that by reducing the fare, the business will be increased. Now this argument is virtually an assertion, that a large amount of trade already in existence, is kept from the railway by the too great cost of transportation, or that by diminishing the price of haulage, a large additional business could be created. Both these positions are undoubtedly true, in some cases, but that they are generally true, more especially in the United States, is what we have not been convinced of, from our own experience or observation, by the perusal of any remarks which have fallen under our notice. The rates of fare are established by the proprietors of public works—generally men of business, consequently cautious—and, to induce them to lessen existing rates, it is necessary to show, that, by a given diminution of fare on certain articles of transportation, a corresponding increase in the quantity of these articles may be confidently anticipated. This can only be done by means of an intimate acquaintance with all the details of the trade in these particular articles—a knowledge to be acquired only by attentively studying all the circumstances which influence the production or consumption of the articles under consideration, in other words, local knowledge. The objection is not to the principle—which may be applicable to all works, varying, however, immensely in the extent of its application—but that no general ~~rates~~ rules can be given, by which the most advantageous rates for the proprietors and the community, can be determined. Perhaps every reader of this journal can refer to some public work, on which a diminution of even 50 per cent. in the fare, would add little to the business, and to others, where he is convinced

that a very considerable reduction in the cost of transportation would not only increase the trade in a much greater ratio, but would even swell the dividends, and in some extreme cases, render investments productive which are now profitless. Among the first, will be found works whose principal income is from the "through"-business, forming a link in some great thoroughfares, such as the Providence and Stonington, and most of the railways in this State; also works of a local character, such as the Boston and Lowell and Paterson, N. J., railways, which derive their revenue almost exclusively from the manufactories. Now the cost of transportation, is of course, an element in the cost of the fabrics of Lowell and Paterson, but so small a one, that it is difficult to believe it capable of influencing the construction of new, or the extension of existing establishments. On the other hand, the consumption of coal is limited to its present extent by its exorbitant price, and that price is principally owing to the great cost of transportation, hence a vast increase in the consumption would be the immediate consequence of the production of that necessary of life at a reasonable cost. It will be urged that all the links of a thoroughfare should belong to the same company or State; but these chains of communication extend in many instances over several States, and even when in the same State, as in the case of the seven distinct railways which will in a few years unite the Hudson and lake Erie, it will be found impracticable to condense the seven corporations into one, owing to the vast difference in the value of the several links, unless the State step in and "assume the mantle" of Engineer-General of railways as well as of canals. This policy was strongly advocated by a prominent member of the assembly of New York, during the last session, and at the same time he very candidly admitted he did not see where the State was to halt in this career, if once entered on. This appears to be the only mode of introducing a regular system of rates of transportation throughout the State, though whether this would be eventually to the advantage of the public, is a very different [redacted], and much more important than any discussion on rates of toll.

Supposing it to be ascertained that a decrease of toll will lead to an increase of traffic, on a certain railway, the great difficulty is to determine the charge which will command the greatest amount of business, and still yield a reasonable profit to the stockholders. In endeavoring to draw additional business to a railway by reducing the tolls, it is absolutely necessary that the reduction should be sufficient to effect that object, and a diminution of 10 per cent. may be

as injurious as a diminution of 30 or 40 per cent. may be advantageous to the proprietors. Experience shows that when the passage from Albany to New York is less than $2, there is no corresponding increase in the number of passengers. The fare is now only $1, with the best and most extensive accommodations ever known, and there can be little risk in asserting that the number of passengers now is not nearly twice that when the fare was $3, several years since, including the natural increase on this great thoroughfare. The general impression appears to be, that $2 is sufficiently low to command very nearly all the travel, and thus afford the public all reasonable accommodation, and the proprietors a fair return for their investment. No one, however, supposes that one or even two dollars, would yield any profit on lake Champlain for carrying passengers 150 miles, from Whitehall to St. John's, though boats may be run much more cheaply on that lake than on the Hudson. Railways differ from each other in their objects, as widely as do these steamboat routes—the latter are rendered profitable by attentively studying all the peculiarities of their field of action and regulating the charges accordingly, and it appears impossible that the same principle should not apply equally well to regulating the tolls on the former. But how are all these local peculiarities to be allowed for in a general law? The community have a right to expect the lowest charges which will yield a fair remuneration to the proprietors for their capital and risk, and this object, we believe will be attained when the charges on any particular railway are so arranged as to conform to the present wants of the particular community on which that railway depends for its present business, and to vary those charges whenever any change in the business of that community justifies and requires such a measure. As already observed, tariffs of freight are made out by men of business, who are notoriously averse to generalities and abstract propositions, and any system or theory of tolls which is expected to produce any useful effect, must be such as they can clearly see through, tracing effects to causes without any other aid than that derived from their ordinary habits of investigation. In this view, we concur, and consider the difficulties in the way of arranging the most advantageous charges so great, as to render inoperative a complete investigation of the kind and extent of the traffic which the railway is to accommodate, increase or create, what its future capabilities and prospects may be, what risk of rival lines, etc., etc., and if the conclusions thence deduced, agree with any proposed theory, confidence in them may be somewhat increased; if they differ, it

is needless to say which will be unhesitatingly adopted. The very object of railways is to facilitate intercourse and diminish the cost of transportation, and their very existence requires that the income should clear expenses, repairs, and renewals, besides yielding a liberal return for the capital invested, as well as for the trouble and risk incurred by those to whose energy and enterprise the public is indebted for their unrivalled facilities; and though believing it to be the interest as well as duty of the proprietors to afford these facilities at the lowest charges, we should still hesitate to assert that the charges on any particular railway were too high, until we knew the cost of its construction, and management, and had studied the nature and extent of the particular trade it was destined to accommodate. W. R. C.

June, 1841.

The subject of finance, although not strictly speaking professional, has attained such importance in the eyes of the community, that no excuse is necessary in offering the following project, furnished by a friend:

For the American Railroad Journal and Mechanics' Magazine.

As an American citizen, I view with a peculiar interest, the present anomalous situation of our monetary affairs in this country, and look with intense anxiety towards the efforts now everywhere manifested among our commercial and productive circles, to direct the eyes of National legislators to this or that plan, having for its object, the creation of a Fiscal Agent of the General government, which may be so constituted as to equalize the exchanges, and restore harmony, reinvigorate enterprise, cherish prudent industry, and by the establishment of a wise system of checks restrain the tendency to wild, erratic, or improvident management of local banking facilities—which has grown up among us within a few years, engendering a spirit of speculation, which, like an epidemic, has spread itself aver every part of our once prosperous and happy country—and left scarcely anything but wreeks of former prosperity—to serve as beacons, warning those who come after us, against the danger of pursuing a like hazardous course.

Numerous, indeed, are the projects which have been already proposed to meet our trying emergency. But as a free discussion of their respective merit is to be expected, most of them have been found wanting in essential qualities—in passing through this ordeal of public opinion, and thus opponents spring up on every side.

Many citizens entertain an idea that it is not within the powers which the constitution confers upon congress, to create a joint stock

corporation at all. Others, that it is impolitic, if they have really the power, to create one with a large capital, fearing that it will be impossible for the whole to be filled up by citizen capitalists without creating new difficulties by the sudden withdrawal of monies from other pursuits of industry or enterprise, and deeming it improper and hostile to the true interests of our own countrymen, to permit the majority of such a capital stock, to be taken by foreign capitalists, who, having no other interests in view than the realization of profits expected for the investment of their monies, might thus gain the possession of an immense power, capable of being used to subvert our democratic institutions in case such a wish exists among them. Many knotty points are disclosed to view in a free discussion of these questions, yet the subject itself is of such vital importance to future prosperity, as seems to demand from all experienced, enlightened, patriotic and practical minds, a thorough, careful, and minute examination of the subject, and by free interchanges of opinion, let us endeavor now to perfect a system which shall be consistent with the constitutional principles of our republic, and at the same time afford ample protection against losses to the industry, enterprise, and prosperity of all classes of our citizens. The experience of past years, has demonstrated the fact, that a check connected with the fiscal operations of the government, can (as a National concern,) exercise a very salutary influence in regulation of local banks and bankers, and if free discussions of suitable plans, to attain so desirable an end as the equalization of domestic exchanges, and protection against sudden expansions and contractions of the circulating medium, shall have the effect of bringing our National legislators to a right conclusion, that *true political sagacity* imperatively requires their early action upon this all important business, then I trust they will weigh well the suggestions of practical business men, whose active pursuits, and daily routine of life, afford to them an immense fund of knowledge of essential details, and their experience of *what is wanted* will enable *them*, perhaps, to advance views and plans more susceptible of being reduced to practice, than might be those of professional theorists in political economy.

Allow me to propose a plan of a Fiscal Agent to be created by congress as a guarantee to bill holders, a regulator of local banks, and to be furnished with such powers as may equalize the domestic exchanges.

First. Let congress enact that the paper circulating medium shall only be issued by an institution to be created by the United

States, which institution shall be restricted from any other business than merely the reception of deposites and the emission of bills in exchange therefor, which bills alone shall form the paper currency of the whole of the United States.

Let congress require that every banking incorporation, or private banker, who design to make discounts, to deposite their specie, or equivalent securities, which forms their banking basis, in the custody of the officers of the United States Institution, before they can exercise the right of discounting.

These Fiscal Agencies to be supported by a prorata tax, to be paid by the different local banks throughout the country.

Let the legislature of each State, as well as the congress of the United States, enact that *these bills shall be a lawful tender* for the payment of all taxes, imposts, duties, and dues of whatsoever kind or nature, established, or to be established hereafter, under their respective legislations; which would introduce a currency in paper, that would be current funds all over the nation, and from the character of the guaranty, *confidence in its stability would be unquestionable*, and specie seldom asked for, except for foreign commercial purposes.

REMARKS ON THE MORTAR USED IN ANCIENT BUILDINGS—WITH OBSERVATIONS AND DIRECTIONS FOR PREPARING MORTAR IN A MORE PERFECT MANNER THAN THAT NOW IN PRACTICE.

The great perfection to which the arts have attained cannot be denied; yet on examining the monuments of former ages, of which many are still to be seen in this country, it does appear that the ancients had some manner of making and using mortar for their buildings, of which our modern artists seem either to be ignorant, or do not choose to put in practice. Although the grand edifices raised under the direction of the artists of the present age, is a proof that our modern masters, by the study of the monuments left us by the ancients, have been enabled to construct buildings vying with their patterns; yet the moderns are still behind the ancients in the construction of buildings with small or promiscuous materials, with that degree of solidity which seems almost to set time itself at defiance.

There is no doubt little difficulty in raising lasting edifices by building immense blocks of solid stone, one upon another—but if we say nothing of the enormous expense of this mode of construction, even where the materials are to be found in the vicinity, there is some consideration necessary when works which require durability are to be constructed, where no large materials can be readily found. Hence the erection of buildings which may be of the utmost importance in a national point of view, as well as to individuals, has to be abandoned, on account of the expense attending the modern plan of construction.

On a careful examination of many of the old castles in this country, it will be seen that the materials which have been used are of the most ordinary kind: and from the manner in which they have stood for such a long period of time, it does most readily occur, that the mortar used in these buildings, has been prepared in a different manner from that practised by modern builders. In fact it will be found that many of these old buildings have been put together with almost every description of stones down to the smallest pebble collected from the bed of the brook, and where no heavy carriages or complicated machinery have been required to construct the most extensive works.

Our ancient bridges and aqueducts all exhibit specimens of the same kind of construction with very small stones; depending therefore on the superior manner of preparing the mortar by which these small materials have been cemented together.

Thus there seems to be an art lost, and in place of endeavoring to recover this art by a series of well conducted experiments, men of genius, and particularly our modern philosophers, seem to have principally in view to bestow their labors in pushing into the world books filled with abstract calculations which they understand only on paper. These calculations are, however, by far too nice, and it is much to be feared that few of the writers could be found to reduce them to practice—and as practical men do not understand them, they are useless to the world. It may be very well for the physician to write a learned prescription intermixed with hieroglyphics, to the apothecary who understands it; but alas! the carpenter and builder have neither time nor inclination to enter into the abstruse analysis of the philosopher. Bred to labor from their early youth, it is only from experience they are accustomed to learn; and it is therefore only from a course of well regulated experiments, described in plain language and simple figures, that the laboring artist's attention can be arrested.

It would, therefore, in almost all cases, be the means of more rapidly diffusing a knowledge of the useful arts, were our seminaries furnished with the means of exhibiting in some degree of experiment, specimens of the various useful arts. For without experience, what is the young engineer who is sent forth to direct the operations of a siege, to raise fortifications, form aqueducts, or construct bridges? It is clear he has yet to learn from the laboring artificer, the essential parts of his business; and thus he is sent forth only with the name, to learn from those of inferior station, who are here found capable of giving instructions from experience, where fine theories and abstruse analysis can be of little avail.

To return, however, to our ancient buildings, where it appears neither time nor labor was lost in the execution. Many of them seem constructed of little else than rubbish thrown together with an outer coating of small stones, or pebbles from the brook, but built with a kind of mortar which appears to have been thin enough to penetrate the smallest crevices, and to form a solid, compact, nay almost an impenetrable body. And if the ruins are considered with the smallest degree of attention, it will convince us that all

the secret of this mode of construction, consists in the preparing and using the mortar which has bid defiance to time, and to the tools of the quarrier to remove, after the lapse of ages. Every workman who has been engaged in taking down any of our old castles, will testify that he has always been able to remove the stone with greater facility than he could disengage the mortar.

How differently then must this mortar have been prepared from the very best which is now prepared by our modern builders; for the latter only dries to fall to dust again when broken into. Another of the grand qualities of the ancient mortar is its being impenetrable to water; and, in fact, the aqueducts for retaining and conveying water which are still to be seen, exhibit no marks of clay or other kind of puddle having been used for retaining the water. Therefore, it does appear that aquatic as well as other works, were frequently constructed of very small stones, by the builders of former ages, and that they were in the practice of forming parts of their buildings into cases or *caissons* of planking, by which means the mortar when run in among the interstices of the small stones, was prevented from escaping.

It can therefore be most readily conceived how easily a building of great magnitude may be constructed at a small expense, and that of the most durable and lasting kind, of materials with which almost every part of our country abounds, if we are only careful in the preparation of the mortar with which these materials are to be cemented together.

It does not appear that the ancients used any other ingredients in their mortar than lime, sand, or calcined earth, such as brick dust, when proper sand could not be procured; and therefore, as already mentioned, the whole secret seems to be the manner of preparation, of which some explanation will now be attempted.

It is presumed the fact is well known, that in the burning of limestone, the fixed air which it contains escapes, and the stone by this means loses it weight. It has indeed long been the practice to grind or slack the lime immediately after being burned, and by means of mortar mills, where the extent of the works can afford them, to prepare the hot mortar for immediate use for building or bedding large materials; but, it is a fact well known that this kind of mortar (to say nothing of the great expense of procuring it,) would be useless in ordinary buildings, as the weight of the substance in thin walls composed of small materials, would not prevent the burstings, cracks, and sets, which would take place; nor, from the consequence of blistering, which always happens when mortar prepared in this way, is used; rendering it unfit for plastering either to withstand the action of the weather, or for lining water courses; because it suddenly dries by the evaporation of its moisture, and consequently, immediately gives way to cracks and shrinking.

On the other hand lime-mortar after lying a considerable time in a sowered state, imbibes again the fixed air which was discharged in the process of burning, and when carefully examined in this state, presents a kind of transparent, or rather icicle, appearance, which destroys in a great measure the binding quality, and which, in our

changeable climate, rarely or ever has the effect of cementing the building. The latter, however, is the manner in which almost all the lime-mortar is most commonly prepared for building, both from a regard to economy as requiring less time, and also with regard to labor; and, it is more than probable it was by hand labor also, that the builders of former ages prepared their mortar. It is therefore to this principle that observations have been directed, of which the following notice is submitted, and which it is hoped, if properly attended to, will enable those who wish to do so, to prepare and use lime-mortar not inferior to that of the ancients.

Sower together a quantity of lime and clean sharp sand for two or three weeks before being used; work this well and turn it aside, and as the proportion of the lime to the sand, will always depend on the quality of the former, all that is necessary is, to take care (in sowering,) if the lime is of a rich quality, to put one-third less lime into the heap, than it is intended to be built with; and, if the lime is of poor quality, say only one-fourth less. (It may here be observed that in general lime of the poorer quality is best for cementing building). When the lime which has been previously sowered, as before directed, is to be used in the building, or otherwise, it is to be again carefully worked over, and one-fourth of quick lime added in proportions, taking care never to have more in preparation than can be used in a short time; and this quick lime should be most completely beaten and incorporated with the sowered lime, and it will be found to have the effect of causing the old lime to set and bind in the most complete manner. It will become perfectly solid without the least evaporation to occasion cracks, which can only ensue in consequence of evaporation; and this can only happen from the want of proper union between the two bodies. But by mixing and beating the quick lime with the sowered mortar, immediately before it is applied to use, the component parts brought so near to each other, that it is impossible either crack or flaw can take place. In short, beating has the effect of closing the interstices of the sand, and a small quantity of lime paste is effectual in fitting and holding the grains together, so as to form a plastic mass by uniting the grains of sand which otherwise would not fit each other. This system will apply to lime-mortar for all descriptions of work, whether for building, plastering in the inside or outside of houses, water cisterns, ground vaults, rough casting, etc., etc.

It may not be improper to mention that whenever there is any difficulty in procuring proper sand for building, clay is an excellent substitute; and all that is necessary is, to make it into balls, and burn it, and then pound it like brick-dust, or pozzolano earth. There is no doubt, in addition to the superior scheme of making mortar in former ages, that, when they used only the small, which we see in the ruins of their buildings, they were in the practice of using temporary casings of boarding which they could move from place to place as the building advanced, and which would enable them to grout or fill up with their quick mortar, all the interstices in the successive layers of stones. And, moreover, by having the boarding of their centering for arches and conduits quite close, they

were enabled to lay on, along with their stone, almost an impenetrable coating of plaster.

From the foregoing observations, it is hoped, it will be most clearly seen that an easy mode of erecting substantial and durable building is generally within our reach, and that the most inferior kind of stones may be used, providing proper care is taken in the preparation of the lime-mortar with which they are to be cemented together. JOHN GIBB, M, Inst. C. E.

Aberdeen, January 2, 1841.

HIWASSEE RAILROAD IRON.

J. Edgar Thompson has forwarded to us the report of S. D. Jacobs, President of the Hiwassee Railroad, on the subject of the manufacture by the company of the railroad iron. The report is a document of considerable interest, and shows satisfactorily to our mind, the propriety of the enterprise by the company. Gen. Jacobs has, in obedience to a resolution of the board of directors, visited the iron district in Pennsylvania, and after an inspection of the works at Pittsburg and the adjacent country, and the most unreserved and intimate intercourse with the most intelligent iron manufacturers of that district, has been convinced of the importance to the Hiwassee company of making their own iron, and hence he has purchased two steam engines, and other machinery, for commencing the work. The estimated cost to put the entire establishment in successful operation, is $55,000, the whole to be propelled by steam with the use of stone-coal, which the report represents as abundant in the immediate vicinity. We are gratified to see the work of manufacturing iron commenced by this enterprising company, and it is by no means visionary to anticipate, that at no distant day, the eastern district in Tennessee will become as distinguished for its iron manufactories as western Pennsylvania, and in the language of Mr. Thompson, "a Southern Pittsburg" may grow up along the line of the Hiwassee Railroad. We take the liberty, without the consent of Mr. Thompson, of giving his entire letter accompanying the report, which affords a theme worthy of much reflection to all who feel an interest in our own great improvements.—*Augusta Chronicle.*

Greensboro, June 7, 1841.

Dear sir—I send you a copy of the report of Gen. S. D. Jacobs, President of the Hiwassee Railroad company, in relation to the manufacture by that company of their railroad iron. The scheme is shown to be entirely practicable, and when carried into effect, will enable the company to procure their iron at one-half the cost it could be delivered in that region from England. And instead of draining the country of its capital, their funds will be disbursed at home, furnishing active employment to the industry of East Tennessee.

This matter is worthy the attention of those having charge of our great State work. If no other object than its ultimate effects upon the prosperity of the region at the northern terminus of their enterprise was considered, it should meet with all the encouragement they are authorised to give it. I look, however, upon the suc-

cessful accomplishment by this company of their new undertaking, connected with our system of internal improvements, as destined to produce more beneficial results upon the prosperity of this section of the Union, than any scheme that has yet been submitted to the consideration of the southern people, and will go farther towards the consummation of their commercial independence.

From the facts stated in the report, it is evident that the establishment about to be erected by the company, will be the nucleus of a southern Pittsburg, the manufacture of which will be distributed by our railroads now in progress over Alabama, Georgia, and Carolina, from the mountains to the sea board. The abundance of coal, iron, and limestone, and the cheapness of bread stuffs in this region, together with the facilities of communication which will shortly be opened to it, must render the success of the enterprise beyond a doubt, producing in its train results with a rapidity as astonishing to those who have not reflected on the subject, as they will be beneficial to the whole country. Yours, etc., J. E. Thompson.

The Croton Aqueduct.—by Oliver Smith.—The city of New York is soon to be supplied with water from the Croton river, a mill stream that rises among the highlands of Westchester and Putnam counties, in the State of New York, and, winding its way in a southwestwardly direction, discharges from thirty to fifty millions of gallons daily into the Hudson, a few miles north of Sing Sing, a village in the same county of Westchester, that has just been spoken of. Across the first mentioned river, and about six miles from its month, and nine miles by the road, in a northeastwardly direction from Sing Sing above named, a dam is now being constructed, the top or lip of which is to be 166 feet above the high tide water at New York; and from the pond thus to be formed, the water is to be conducted upon an inclined plane, (and of course it must be so conducted, if conducted at all, for no locks are admissible in such a case) commencing at an elevation of 153 feet above the tide water aforesaid, and descending generally about fourteen inches in a mile for the distance, including the windings, and its course is very serpentine, of about 33 miles, to the Harlem river, where it will be 120 feet above the same tide water of which we have already spoken; and furthermore, it is still to be continued in various modes, across that river about 9 miles, first to a receiving reservoir which is to hold 158,000,000 gallons, and thence through iron pipes to a distributing one which is to hold 19,000,000 gallons; the latter being something like three miles to the north of the City Hall of the same city above mentioned; and thence it is to be sent again through iron pipes to the houses and other places where it may be required for use. And of this work which is now nearly complete the expense is likely to be, according to the recent message of the Mayor, abont $12,000,000.

The region of country through which this aqueduct passes is very uneven, and notwithstanding every practicable effort was made to avoid hills and valleys in locating it, still many of both were found in its way, so that in constructing it, as may be supposed, several tunnels and many deep cuts were made, and many low places were raised, with earth and masonry, to its level.

The aqueduct proper, or the channel in which the water in this case passes, is constructed thus:—Two walls are erected of common stone masonry, and lined upon their inside with one course of bricks, which rest upon other bricks that are placed edgewise in the form of an inverted arch

of 9 inches in depression; and these walls, thus constucted of stone masonry and brick lining, are 6 feet and 9 in. apart from the inside of the one to that of the other, and 2 feet 8 inches thick at the bottom; and slope upward 4 in. upon each side to the height of 4 ft., so as to be 7 feet 9 in. apart from inside to inside and 2 feet thick at the top; and upon them is a semi-circular arch that is 8 inches thick; and above the whole, when completed, the loose earth is thrown to the depth, or rather altitude, of about 4 feet, to prevent the water which is to run below it from freezing during the winter season. It is not intended that the water shall rise in this case above the spring of the arch above, or top of the side walls of which we have spoken, and which, as we have already said, are 4 feet high; and adding 6 inches as an average for the 9 inches in the depression of the inverted arch that has just been mentioned, we shall have $4\frac{1}{2}$ feet for the height of the water in this aqueduct; and its width being $6\frac{3}{4}$ feet at the bottom, and 7 5-12 feet at the top, will be equivalent to 7 feet; and thus we shall have 31 1-2 or 32 feet at the most for the area of the end of the stream.

Had this aqueduct been constructed wholly of bricks, its form should have been cylindric like that of an ordinary sewer, and the ring or zone should have been one foot thick; but such a structure would have been much more expensive, and no better than might have been the present one with a little variation, which we shall now point out.

In the 2d volume of Hutton's Mathematics, it is shown how piers and walls should be constructed, in order that they may support a given arch; and calculations made pursuant to this demonstration will indicate that the walls of which we have spoken above should have had about *eight* inches more of leverage at the bottom; that is, had their base extended *twelve* instead of *four* inches outwardly beyond their top, their exterior sides thus sloping upward, and their other parts remaining as the same now are, they would have snpported the arch and the earth above them; while, as the case actually is, they do not do so, but are pressed with considerable force upon the earth which is thrown up against them. And no harm, it is true, will result from this circumstance where the aqueduct in question is wholly beneath the surface of the ground, for there its walls may, and doubtless have been, actually prevented from spreading in the least, by having the earth that is thrown in between them and the bank beyond trodden and beaten down firmly and compactly; but where there is an embankment the same is not so easily effected. The loose earth that is in this latter case thrown up against the walls, yields more or less as they are pressed upon it; and contractors and overseers upon this work have told me, that in consequence of the spreading of these walls, many wide openings appear occasionally in the arches above and below, and that they have been obliged to stop the same, and sometimes more than once, with mortar, in order that their work might bear inspection.

This, however, should not be so. A little science, aided by what would have probably been no additional expense at all, would have built those walls so that they would not have spread in any place, whether in case of an embankment or deep cut; while, for the want of that science, the work in question may give way, and no body knows how soon; and its engineers have no excuse for such ignorance, and especially among the many schoolmasters who are every where abroad, and gladto instruct for a respectable living.

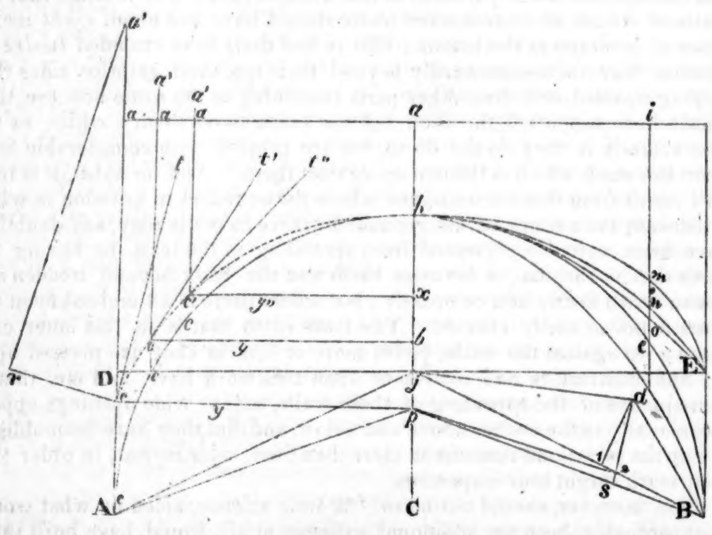
We perceive that from the bottom of the aqueduct to the top or lip of the dam is 13 feet; and that from the highest point to which it can ever be desired to have the water rise in the aqueduct, to the lip of the dam, is 8 feet, if the engineers state correctly; and hence we can readily imagine how a

sluice may be constructed that will throw the water into this aqueduct with considerable velocity.

A mile of this aqueduct will contain about 1,250,000 gallons; and it is supposed that the present population of the city will require 7,000,000 gallons of water a day; and hence, if the water fills the aqueduct, and moves at the rate of about six miles a day, it will be sufficient in quantity for the present.

The Croton river is calculated to yield, when rather full than otherwise, about 50,000,000 gallons of water a day; and this, with a velocity of something less than two miles an hour, would all run through the aqueduct; so that as to the dimensions of this channel I have no criticism to offer at present.

Of the structure in question, some of the arches that occur over roads, ravines, etc., are elliptic, while the rest are circular ones; and those for the bridge which is now being erected in the same structure over the Harlem river, are intended, according to the plan which the engineers publicly exhibit, to be semi-circular. These arches are to be 15 in number; eight of them are to be over the river, and the other seven will be over the low ground which happens to be found upon the north-east or Westchester side of this river. Of the arches over the river, the piers from centre to centre are to be 94 feet apart, and of the other, the piers measured in the same way will be 57 feet apart; making a distance of 1,151 feet for the whole bridge, and the same is estimated to cost about $9,000,000.



A B, the span of the large arches, is to be 80 feet, and of the small ones 50 feet; and C h, the elevation in the one case, is to be 25 feet, and in the other 40 feet of course, as we are to have semicircles; and consequently, of the large arches the piers will be 14 feet thick, or in the direction of the bridge at the top, while those of the small ones will be only 7 feet there in that direction.

In order that vessels may pass conveniently upon the Harlem river beneath this bridge, the Legislature of the State have directed that the soffit beneath the crown of the large arches at h, shall be at least 100 feet above the surface of the water below it; and this altitude, it will be borne in mind

is about 20 feet below the level of the aqueduct; and to avoid the expense as well as the weight of this 20 feet of structure, it is proposed to conduct the water across this bridge in iron pipes, to be laid in the form of an inverted siphon; that is, the water will descend into them upon the Westchester side, and rise again to its proper level upon the New York side of this river, and thus pass on to the city; and in the same manner too, though the circumstance may not be exactly in our way just now, it is to be conducted across a wide and deep valley a little further downward at Manhattanville.

These pipes are to be three feet in diameter within; and of course four of them, the number proposed in this case, will present an area at their end of only about 28¼ feet, which is something less than the terminal area of the previous portion of the aqueduct, which we have just shown to be about 32 feet. However, in a recent report of the chief engineer of this work, I perceive he proposes to give the water a fall of two feet in passing through these pipes, a circumstance that will doubtless fully compensate for their deficiency in dimensions. But still, if this work were mine, I should increase their diameter, and thus reserve the two feet of descent for the distributing reservoir.

If these pipes were laid close together, they would cover a space of only about 12 feet in width; but in order that one piece may be conveniently and properly joined with another, it will be necessary to spread them so that they will occupy a space about 15 feet wide; and to prevent the water that will pass through them during the winter season from freezing, it is proposed to have about four feet of earth upon every side of them; so that on the whole, this bridge must be 26 feet wide, and have an extrade of 12 feet in altitude above the crown at *h*. The spandrel walls, which are to be two feet thick, are to be carried up to the height of *sixteen* feet above the same point at *h*. Here, then, we have two walls, 2 feet thick, 4 feet high, and 1151 feet long, equal to 18,416 feet of solid masonry, for which a light cast iron railing should be substituted; and it will be readily perceived that this latter guard would be proper, in order to prevent accidents to persons who will naturally visit this work from time to time, and often in crowds.

I observe that the foundation of the piers for the large arches is 26 feet thick, or in the direction of the bridge, and 36 feet wide; but this is suddenly contracted to 20 by 30 feet, which may be considered as their real base; and their height from the bottom of the river, which we shall suppose to average 20 feet in depth, is 80 feet; so that it will be sufficiently obvious without any calculations just now, that none of these arches will be able to stand alone. Should either of them fall, the whole 15, including all the piers, would follow it and thus constitute a dam across the river, whose navigation so much expense is now incurred to preserve. But this should not be so. Such a work will be a disgrace to the 19th century. The scientific observer, associating the idea of top-heaviness and tendency to fall will almost shudder to look at it.

The hances above *d* are intended to be filled up with masonry that will be two-fifths cavernous; and of course its specific gravity will be about the same as that of the earth and the water including the pipes above it; and hence, we have the simplest case for equilibrating, according to the well known formula to which many contributed, but which seems to have been generalized and completed by Hutton. It is true we have two extrades here. Upon the edges of the arch we are to have one of 16 feet in altitude; and in the centre, another of 12 feet from the crown *h*; but from actual calculation I find that 13 feet may be taken as an average extrade in this case,

without any sensible error; and besides, the intended parapet walls above *a a* should not be made.

Applying the formula above alluded to, we find that if the space B *e h d* B is filled up like the rest above it, the line of pressure or thrust *h d* B commencing at the crown, will be so situated below the circular curve, that if the line *i d* is drawn perpendiculary downward from the top of the extrade *a a i* to the line of pressure in question, and through the place where the same is the farthest in a perpendicular direction from the circular curve just mentioned, the distance *i d* will be 100, when that of *i e* to the semicircle already referred to is 80.

Now let us suppose the piers to be raised about 20 feet higher, to D and E, and then we shall have an elevation *j h*, of 20 feet; and in this case, the spacc E *o h n* E being filled up like the rest above it, and the line *i o* drawn as before to the line of pressure, the same *i o* will be 100, when *i n* to the circular curve is 93; and this arch would be as good for the purpose in question as the other will be; for any concussion that would throw it down would be likely to destroy one of double its elevation and of the same span; and thus we get rid of a large mass of masonry between the curves B *d h* and E *o h*, which for all the arches in question would be worth many thousands of dollars.

If the large arches are semicircles, and if the top of all the piers both of the large and the small ones are brought, as good taste will require, to the same level, it will follow that a large amount of masonry & filling will be necessary upon the small arches, to the amount of 15 ft. in altitude, more than will be needed upon the large ones; and hence, by adopting for the latter an elevation of only 20 feet, we shall be making a great improvement, besides dispensing with the wall upon each side, of which we have already spoken.

Along the line of pressure B *d h* in the one case, or E *o h* in the other should be placed the vousoirs or arch stones; and thus we should have the arch of *equilibration*, which would be pressed in all places alike, and have no tendency to rise up or sink down at one point more than at another.

If the vousoirs are placed along the circular curve B *e h*, the space B *e h d* B not being filled up like the rest above it, then the line of thrust will pass above B *e o*, in the direction *h c' c'* etc., which is represented by the dotted curve on the left, but which is not intended, be it remembered, as a continuation of the circular curve E *n h*.

The equation or locus of the curve *h c' c'* etc. is probably no where given, though it may be readily obtained as follows:—Call $r\,c' = a\,h = 13$ in this case, and $a'\,c' = a\,c = w = 53$, and the angle at *r* a right one, and *t c' r* being also a right angle, that of *p c' t* will be found to be 73°, the natural tangent of which, radius being 40, will be 173. Now call $h\,p = x$, and $p\,c = y$, and the tangent in question will be $\frac{dx}{dy}$; and in the second volume of Hutton's mathematics, page 501 of the edition before me, it is shown that this tangent increases as the weight $w = a'\,c' = a\,c$ does in passing from the crown at *h* to *c' c'* etc., and thus to the spring; hence we shall have $dw = C \cdot d\left(\frac{dx}{dy}\right)$; but $w = 13$ in this case, when *x* and *y* both equal 0; and therefore, $53 - 13 = 40 = C \cdot 173$; or $C = \frac{40}{173}$; and thus $w - 13 = \frac{40\,d\,x}{173\,d\,y}$; but $y^2 = (40)^2 - (53 - w)^2$; or $d\,y = \frac{53dw - wdw}{\sqrt{106\,w - w^2 - 1209}}$; or

$$\int \frac{66wdw - w^2\,dw - 689dw}{\sqrt{106w - w^2 - 1209}} = \frac{40x}{173}.$$

Of this equation, the left-hand side may be integrated in three distinct series; but the numerical calculation thus indicated are formidable enough, and may not be soon made. By taking $y=1, 2, 3$, etc., successively, and thence obtaining the corresponding values of w however, we can ascertain the respective angles $x\,c'\,t''$, $b\,c'\,t$, $p\,c'\,t$ etc.; $p\,c'$ being an ordinate and $c'\,t$ a tangent to the curve. But however short we may take y, as long as it has any assignable length at all we shall always bring the curve $h\,c'\,c'$ etc. too low down or too near the circular one $h\,c\,c$, etc.: and unless y is taken very short indeed, the circular curve will prove to be the *upper* one of the two. However, in an arch of almost any given curvature, whether circular, elliptic, cycloidal, parabolic, or hyperbolic, whose extrade is of a uniform specific, gravity, and raised much above the crown and level upon the top, the line of thrust will pass above the curve; and if a row of vousoirs is placed along this curve, another one should be placed above it in the line $h\,c'\,c'$ etc. of thrust; and hence we perceive that it is merely by *accident* that such arches stand. If the masonry along the curve $h\,c'\,c'$ etc. is strong enough to be a substitute for vousoirs, very well, the arch will stand; but if it yields, as it always does more or less, the crown of the arch will settle down, and the hanches will rise up; and if the whole arch dees not fall, no thanks are due to the architect or the design.

The elliptic curve $h\,m$ E is obviously as far from equilibration as the circular one is; and in all semi-peripheries, whether of a circle, an ellipse, etc., the tangent of the angle $x\,c'\,t''\,h\,c'\,t'\,p\,c'\,t'$ etc. becomes infinite at the spring or top of the piers, and therefore the weight or w will be so there too; but in the flat arch it never becomes anything, and consequently the thrust in such cases is always horizontal like that of a wedge; and even in the proper arch the principle is the same; for $a'\,c'$ must effect a pressure in the direction $r\,c$ toward the curvature, equal to that of $a\,h$ at the crown, and this is analogous to a blow upon the head of a wedge; and the remaining force of $a'\,c'=a\,c$ is in the direction $t\,c'$ upon the pier and similar to the horizontal thrust of a wedge; so simple is this subject, and even dynamics generally, when properly understood.

Persons who ought to know better tell us about equilibrating an arch by giving a certain form to the vousoirs. Let us look at this a little. The line d 1 being drawn at right angles to B j, the vousoirs B d 1 and $j\,d$ 1 will have no tendency to slide upon each other; and so in all cases the junctures of the vousoirs should tend toward the centre of the curvature of the line of thrust in an arch, or so as to fall at right angles to a line drawn from one juncture to another, when straight bars are put together end to end, as B $d\,d\,j$, j A. If the vousoirs are in the form, however, B d 2 and $j\,d$ 2, they will have a tendency to slide upon each other, though their mutual friction may prevent actual sliding.

Now draw B p perpendicular to d 2, continued to s, and then alter the intrade or line of thrust to B 2, 2 p, p A, and the vousoirs B 2 s and p 2 s will have no tendency to slide upon each other; but this and all other variations of the intrade will require a corres-

ponding variation of the extrade; and those who tell us about making the same extrade suitable for any intrade whatever, merely by giving what they call the "*proper form to the vousoirs*," talk very foolishly, to say the best of them; and Hutton and Gregory speak of them with much contempt.

It is equally foolish to attempt to equilibrate an arch in an experimental manner, by hanging weights upon a chain that is attached at both ends so as to hang loosely, and thus to form a curve. The thing is wholly impracticable; for there is only one chance among an infinite number that the experimenter will succeed in his efforts. In short, as Hutton and Gregory, and many others assure us, there is but one practicable method of equilibrating an arch; and that is, first, to know the extrade, span and eleuation, and from thence to calculate the line of thrust, and there to place the vousoirs. The operation is simple and easily effected; and it is surprising to me, at least that so few understand it. Many who pass for good dynamicians will preach a long lecture about a certain "*friction*," which none, as they contend, but the practical builder can possibly appreciate. As to this "*friction*," however, I have just said all substantially that is to be said about it; and if those who pretend to be able to think cannot understand it, how can those do so who never think at all?

Again, we are leetured about cutting the vousoirs *properly*. Upon this point, too, I have just stated all that the practical builder or any one else understands or knows, and all that exists; and if those who call themselves dynamicians do not comprehend it, I should like to know what they do comprehend.

But I am reminded that circular and elliptic arches are found to stand. True, they do so generally, though they sometimes fail; and I have just given the reason why they do either. How foolish it is to place the vousoirs where they will be of no use whatever, and then to substitute loose masonry for them where the true ones should be? But the peasant would persist in putting a stone at the mouth of his bag, to balance the grain at the bottom of it, whenever he had occasion to carry that grain at all, because his ancestors had done so before him; and equally bigoted, ignorant and foolish are mechanics now in erecting any arch but the one that is calculated from the span, elevation and extrade.

If it is true that a circular or elliptic arch over a door or window in the side of a building, is just as good as the calculated one; and that, too, because the masonry, where the line of thrust actually passes, in such a case is equally firm as is that which consists of vousoirs; but the same is not generally true in the arch of a bridge.

Let the large arches under consideration be divested of the parapet walls of which we have already spoken; let them have a moderate elevation, and be equilibrated; and let the piers upon which they are to stand be extended to 40 feet at their base, and be contracted to 6 feet at the top, in the direction of the bridge, and let them be three-fifths cavernous; and any two of them will support the arch that is to rest upon them. Thus constructed, their

thickness would be equivalent to 23 feet; while that of those which are now being erected is 17 feet. Three-fifths of the latter is 10⅕, and two-fifths of the former is 9⅕. Thus my piers would contain less masonry than will those which are now intended. Making mine one-half cavernous, their solid contents would be to that of the intended ones as 11⅓ to 10⅕. But I should have 1524 feet of solid masonry for each pier from the parapet walls, for which I have proposed above, to substitute an iron railing, and this would enable me to make my piers about as solid as the intended ones are to be.

Again, placing the vousoirs where they should be, along the line of thrust in these arches, I would obviate the necessity of all that masonry which is intended to be put upon the hances and top of the piers as a substitute for vousoirs; and thus by putting loose earth, or nothing at all in its place, I would save in each of those arches about 10,000 cubic feet of solid masonry, which would be equal to about one-half of one of the intended piers! Look at this! What pains are taken to make the piers in this case slender, and the arches heavy—uselessly, ridiculously, nay even frightfully heavy!

But again, have one pipe of about 6½ feet in diameter, instead of four that are each 3 feet in diameter, for conducting the water across this bridge; and then the arches in question, and consequently the whole structure, piers and all, may be reduced from 26 to about 15 feet in width—nearly one-half! and even this pipe would have as much earth and stone at its sides as will the exterior onesin the plan proposed. But this is not all. Instead of surrounding this pipe with earth to the thickness of 4 or 5 feet: inclose it in an airtight case: and then it will not be necessary to make this bridge more than ten feet wide for one foot in thickness, if confined air will prevent the water in question from freezing. We all know this to be so and it is *criminal* to pretend that we do not. We ought to raise our voices in defence of science, which is treated with so much contempt in this case. Any fluid, whether liquid or gaseous, will take caloric very readily from any substance with which it comes in actual contact, and will yield the same again with equal readiness to any substance with which it happens to meet; though it radiates or emits caloric very slowly, if at all. It is a good transporter, in case it has its liberty, but a bad radiator of caloric; and hence, if properly confined, it becomes a better insulator of caloric than is anything else.

No other use can ever be made of this bridge than to conduct the water in question across it, and for this purpose solely should it be erected. The piers should have a large base and a small top, and be very cavernous. Upon them light arches should be placed about ten feet wide, and upon these arches should be laid an iron pipe about 6½ feet in diameter within; and this pipe should be inclosed in an air-tight brick case, whose walls should be only eight inches thick; and one foot is distance enough for their inside to be from the pipe. And the water thus protected could never freeze while passing across this bridge. But as a further precaution, I would build an oven in the chamber which is to contain the influ-

ent water upon the Westchester side of this river, and in this oven a fire could be made during cold weather, and thus communicate all its caloric to the water; but no such fire would ever be required. And thus we could have a bridge with equilibrated arches that would stand alone, for less than one-half of what it will now cost for one with arches that will not be equilibrated and will not stand alane! But in case of an earthquake, or a small failure in its materials, it will dam the river, and cease to bear water to this city. And why should we pay $900,000 for a bridge in this case, when we can have so much better for about $300,000?

Stones of all kinds, it is well known, are subject more or less to disintegration and decomposition; and that it is within the sphere of possibilities that some one of these arches may fall, and that too within a few hundred years; and every one will readily imagine that if such a catastrophe should occur while human inhabitants remain upon this island, they will look back and wish that the work in question had been differently constructed.

We should not now, in the nineteenth century, put up such a bridge, and especially when the proper one can be made for less than half the money. To do so is an outrage upon the science of the day. Future generations will think we were crazy, for they will be certainly aware that we ought to have known better.

Mr. Frost, a very ingenious mechanic of Brooklyn, N. Y., has suggested another method for building this bridge; "Have no arches or pipes; but instead of them, lay from pier to pier a trough made of *cast* iron plates. These plates should be 10 feet long, 6 feet wide, and 1½ inches thick; and they might be put together very firmly, end to end, without any *wrought* iron fastenings; and the side plates thus fastened; and standing as they would be, edgewise, would support the stream of water that would pass between them. But this trough might be braced with cast iron bars running to the piers; and let it be inclosed in another one made air tight; and this would add its own strength to the first, and prevent the water in the same from freezing. In this case the piers should be just wide enough apart so that any vessel might pass conveniently between them, and should be raised 120 feet, to the level of the aqueduct. They should be hollow and light, like a shot tower, though their base should be large enough to enable them to stand firmly, and especially in the direction with the river: and they might be bound together with bars of iron, running up endwise in tneir sides, so that they would never break off; for we would not have their crust or rind more than two feet thick."

This would be certainly a very cheap and permanent method of conducting the water across the river in question.

INVENTION OF THE SELF-ACTING CLEANSING MACHINE FOR THE PREVENTION OF PRIMING.

In a very favorable review of this work in the Civil Engineer and Architect's Journal for December, 1837, it is properly stated, as a well known fact, "that the enginc primes in proportion as the water is dirty,

and the remedy is to empty the boiler and clean it out."* So perfectly true is this with respect to boilers under ordinary circumstances, and so great are the evil consequences generally arising from having foul water in boilers, that the great cause of complaint among all who have been concerned with the management of engines, has always been the difficulty of resorting sufficiently frequent to the operation of cleaning out. Persons who have only a superficial acquaintance with the steam engine, and who treat the boiler merely like a large culinary utensil, are apt to conclude that, provided the boiler is occasionally swept out, so as to prevent any adhesion and consequent burning out of the iron, nothing more is needed; but the experienced operative knows very well, that, if his engine be heavily loaded, and his boiler supplied with the ordinary water to be found in large towns, which usually contains a greasy or slimy kind of dirt, then, instead of the boiler bottom being in any danger of burning out from this cause, he will seldom find much dirt upon the boiler bottom itself, but by far the greater portion will be found sticking up against the roof, or inside of the top of the boiler, and against the back end, but always *above* the surface of the water. We frequently find that the dirt in this manner spread over a very considerable area to the thickness of a couple of inches, and mnch thicker in some particular places, such as in the angles and about the straps to which the stays are attached.

Being impressed with the importance of attending to the above considerations, as regarding obstacles which seemed to lie at the root of all further improvement in the steam engine, and besides being convinced by repeated experiments, that in all cases there is a great saving in fuel and tallow by cleaning out the boiler once a week instead of once a month;† we became of opinion that if means could be devised for cleaning out a boiler *daily*, or oftener if needed, without wasting much hot water, a great desideratum would be accomplished. With these views we commenced, nearly a dozen years ago, the solution of the following problem, namely:—How to clean out a boiler without having it emptied and without stopping the engine, and thereby to supersede as far as possible the disagreeable necessity of sending men inside for that purpose? Now this was not a question to be easily answered off hand, neither was its direct solution to be evaded by some lucky thought, such as contriving a particular shape of boiler for the purpose, but the invention, to be useful, must be applicable to all sorts of boilers. Consequently there appeared to be no method of procedure so likely to be successful as the old one of the mathematicians in all cases of difficulty, namely, that of *trial and error;* accordingly that was the method resorted to on this occasion; and as might be expected, although success was eventually sure, it came slowly, and in August, 1829, the first complete cleansing machine was applied to a 20 horse boiler belonging to Thomas Marsland, Esq., M. P. for Stockport.

Of course the first machine made, as we expected at the time, only partially answered the purpose of keeping the boiler clean, but it did so sufficiently well to completely prevent the priming of the engine, and was so far effective in other respects that the boiler was found to be cleaner at the expiration of thirteen weeks continued working than it had been before at the end of two. From the continual and gradual improvement upon almost every new machine that was made during the succeeding seven years,

* The Civil Engineer and Architect's Journal, Vol. 1. pages 37, 121, and 176. London, 1838.

† A period of *three days* was recently found to be the utmost limit that could be allowed, and at a factory near Stockport, without the engine priming, although there were two 50 horse boilers to one 70 horse engine.

accompanied, as may be supposed, by not a little labor and many disappointments, the apparatus was at last rendered perfect. Indeed for the last three years, so far as it is required to free a boiler from mud, sand, clay, salt, or *loose* sediment of any kind whatever, we can pronounce the cleansing machine to be quite perfect and admitting of no further improvement. There are at this time, 1839, nearly one thousand of these machines in use, principally in Lancashire, Yorkshire, Durham, and Northumberland, so that any considerations in the construction of a boiler, with a view to the necessity of a man going inside to sweep it out, may be safely discarded.

Mr. Marsland of course deserves the credit of being the first among the very few manufacturers who were willing to allow the apparatus to be tried at all, and he has, or rather the firms with which he is connected have, now, at their extensive cotton and print works, no fewer than sixteen of these machines at work, which have been made at various times during the progress of the improvements. This gentleman was also the first manufacturer in the district to try Mr. Samuel Hall's patent method of condensing without injection, which by enabling the boiler to be supplied with distilled water, also offered apparently the only plausible means of preserving the boiler. The plan, however, as is well known here, totally failed, as it was given up, after long and very expensive experiments at Messrs. Marsland's Portwood mill, in Stockport.*

The first cleansing machine for a locomotive boiler was made for Messrs. Galloway, Bowman and Glasgow's engine, the Caledonian, belonging to the Liverpool and Manchester railway company, in 1833. This engine was the first locomotive that was made with the boiler oval in section, and was worked with great success for some years as a bank engine on the above railway. The first complete machine for a marine boiler was made in 1835, and the apparatus was fully proved to act well in the city of Dublin company's steam packet the Shamrock, in the summer of 1835; this vessel we believe being the first which had the cylindrical marine boilers with numerous tubular flues, which boilers, we may here remark, are the only kind that are capable of bearing any considerable pressure of steam, without which the advantage of working steam expansively is, at the best, questionable in *commercial* steamers.

We are thus particular in stating the above facts, because since the publication of the first edition of this essay we have had sundry applications from various quarters, both in this country and the continent, respecting the cleansing machine; and it may have some trouble to parties at a distance in being informed, that the cost of the machine in Manchester is from 12*l.* to 15*l.* It has been entirely uphill work to bring this invention to its present state of perfection, while the author acknowledges that his perseverance was not a little stimulated by many first-rate scientific mechanics pronouncing his task to be hopeless. He would advise his brother mechanics who may have similar obstacles to encounter, to pursue the object they may have in view, and equally avoid having any connection with either *patents* or *patrons*, unless the latter make their first appearance in the shape of customers. Many of our applicants have expressed great surprise at not having heard of the apparatus previously through some of the scientific publications, we can assure them, that if they delay the adoption of improvements until they are sanctioned by the approval of the editors of scientific journals, they may safely calculate on being at least ten years behind their brother manufacturers in this country. The most successful

* This was Mr. Hall's second patent for the same object; his first had been previously tried at Mr. Sherratt's foundry, in Manchester.

manufacturers in Lancashire do not generally look into books for improvementi in machinery, and still less do they consult the advertisements of inventors and patentees for that purpose.

No doubt the best policy of the mechanical engineer in regard to the propriety of adopting improvements in any kind of steam engine apparatus, is that ascribed to Mr. Field in his fitting up of the Great Western steam-ship, who, it seems, preserved "a prudent mean between the rejection of all untried expedients on the one hand, and the rash adoption of crude projects on the other."* But it is no very easy matter, for even the best informed engineer, to hit this happy medium;—very great talent, as well as much labor and research, must be necessary to enable him to avoid being frequently egregiously deceived by some of the immense multitude of inventions that are constantly offered to his notice; among which it may also happen to be far from being an *untried* scheme that is entitled to be considered a *crude* project. The most crude and clumsy of projects, and those which have been tried and laid aside scores of times, are constantly being revived and re-patented; and when brought out in connection with a long purse, are almost sure to take at first; while the real mechanic who makes useful practical improvements, may struggle in obscurity for a lifetime, unless he resort to that advertising quackery which gives to the worthless inventions of his rich competitor nearly all their eclat. It is surprising what a progress a clever monopolising patentee will make, in a very short space of time, with a railway or steam navigation company, as compared with his almost uniform want of success with the enterprising cotton spinner, who rarely deputes any subordinate agent to *think* for him on the expediency of adopting any new plans, however well such agents may be able to manage the old ones.

A Yankee Boring Iron.—From some source, which that paper says "authentic," the Philadelphia Chronicle learns that a person in Marblehead Mass., has invented and put into practice a machine by which he can descend to the bottom of the deepest water. Attached to this sub-marine article are several augers, by which the person in attendance can in a few minutes bore a hole through the bottom of the strongest copper-fastened vessel, and in a short time sink her. One man with such a machine can successfully contend against whole fleets at anchor.

REPORT OF THE ENGINEER IN CHIEF OF THE GEORGIA RAILROAD AND BANKING COMPANY, TO THE STOCKHOLDERS, *May* 10, 1840.

(Continued from page 336.)

At this stage of our operations, it is proper that I should present to the board a consolidated statement, of the various estimates heretofore submitted by me, and upon which they have authorized their expenditures.

Estimated cost of the Union road including depots and machinery, submitted May, 1836,		$1,051,209 00
Estimate of	Madison branch, May, 1838,	607,874 00
"	Athens " " "	398,936 00
"	Machinery, etc. for both branches,	160,000 00
"	Warrenton branch,	32,000 00
	Total,	$2,250,019 00

This sum is inclusive of real estate, right of way, and interest on advances by the bank to the road, amounting to $172,654, items for which I could not then venture even an approximate estimate. To these might also be added no inconsiderable sum paid for exchanges in consequence of the depreciation of the currency since the first suspension of the banks. The estimates for the first and largest item in the above statement were made before the great rise in the price of nearly every element which enters into the cost of Railroads; yet notwithstanding this and other disadvantageous circumstances, the actual cost of the whole work, embracing a distance of 147 miles—a large portion of the route passing over ground of unusual difficulty, will not be found to differ $25,000 from the estimates.

The business of the Road during the year ending on the 31st of March, has not been as flattering as the previous years, owing chiefly to the failure of the cotton crop, which probably occured to a greater extent in the counties tributary to our Road than in any other portions of the South.

A decrease in the travel, a necessary consequence of a short crop, will also be observed by the returns. The same influence would likewise have extended itself to the up freight, had not the former prudence of the merchants of the interior suffered their stocks of goods to become unusually light, and in consequence, the Spring business up has been under all the circumstances, very fair. It is also satisfactory to observe from the destination of the merchandize passing over our Road, that the circle of our customers is continually extending and now embraces a large portion of the States of Alabama and Tennessee.

The following statement exhibits a general view of the receipts and disbursements for the year, on the Road in use, averaging 105 miles in length. It will be recollected in comparing it with last years statement, that the latter was for 11 months, and that although the Road was extended on one Branch 14 miles and on the other 6 to 12 miles, the charges for the up freight remained the same, and on cotton it was reduced from $1 50, the price charged from Greensboro, to $1 25 per bale from Buck Head. For more detailed statements of the buisness and expenses of the Road, I refer you to the accompanying documents marked Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12.

Business of the Georgia Railroad for 12 *months ending March* 31*st*, 1841.

Receipts for Freight Up,	$37,463 61	
" " " Down,	28,963 71	
" " Passengers Up,	33,329 02	
" " " Down,	32,933 02	
" " Mails,	22,373 52	
" " Miscellaneous,	3,162 23	
Total,		158,225 11
Expenses of Conducting Transportation,	17,869 60	
" " Motive Power,	22,652 58	
" " Maintenance of Way,	21,836 61	
" " " " Cars,	4,924 25	
Total,		67,283 34
Leaving net profit,		$90,941 77

Equal to *six* per cent. on the cost of the road in use, notwithstanding the short crop and reduced rates.

In addition to the regular business above enumerated, there was con-

veyed on the road materials for the superstructure, etc. of both branches, as follows:

912,000 feet, B. M. of string pieces, cross ties, and mud sills, which, at $1 per M. per 10 miles, is	$6,384 00
65,000 feet, B. M. for bridges, at $5 per M.,	325 00
24,000 " " " Depots, at $6 " "	144 00
1,650 tons of Iron and spikes, at $9 " ton,	14,850 00
Total,	$21,703 00

During the preceding 11 months a large amount of similar transportation was done of which no account was taken, and I now only refer to it to exhibit the true amount of business compared with the expenses, which is the customary, though delusive method of ascertaining the economy of railroad management. If we follow out this mode of comparison, it will be seen that our expenses are but 30 per cent of the income supposing the business to have been the same.

To accomplish the years business our trains have traversed a distance of 110,540 miles,—dividing the expenses ($67,283 34) by this, will give the average cost of working the road per mile run 60 8-10 cents. The expenses for the last *eleven months* were over 63 4-10 cents per mile.

The item for maintenance of way, it will be recollected embraces the damages sustained by the finished road from the freshets of May 1840 and March 1841, so far as the latter has advaced on the first instant. The injury sustained from the May freshet by the road in use, was principal confined to that part overflowed by the Savannah river, and from the March freshet, to two breaks in the embankments 16 miles from Augusta, and several slips in the cuts along the line, of more or less extent, only one of which, in a cut 30 feet in depth, adjoining the Oconee, was of sufficient extent to interrupt the travel. At both periods the transportation of freight was stopped for about a week, but from the fortunate position of our trains at the time the travel was not materially interrupted.

In conducting the business of the company, I have the pleasure to state that I have received from all the Officers and Agents in the several departments under my control cordial co-operation in the discharge of the various duties devolving on them, and whenever extraordinary services were required, they have been cheerfully rendered. The duties of Superintendant of Transportation and Assistant General Agent, are still performed by Richard Peters, Jr., with unabated ardor and devotion to the interest of the Company.

I would recommend a renewal of the application to the Legislature for the privilege of increasing our rates for passage to at least $6\frac{1}{4}$ cents per mile.

If the Railroad Companies North of us, and the Stage proprietors South, could be induced to reduce their rates to our scale, the additional travel which would thereby be diverted from the Mississippi to this route would no doubt fully compensate all for the decrease of rates, but as that object has hitherto been opposed by these companies in a manner which leaves but little expectation of its being soon carried out, I can see no sufficient reason why we who have to incur the additional expense and risk of a night line in both directions, should be compelled to receive at least 20 per cent less than other companies, especially when it is recollected that the additional charges would fall chiefly upon non-residents of the State.

Respectfully submitted by

Your obedient servant,

J. Edgar Thomson,

Chief Engineer and General Agent.

Names of Engines.	Makers' Names	and Class.	Commencement of service.	Number of miles run by each engine, from 1st of April, 1840, to 1st of April, 1841.		* Cost of extraordinary repairs of cnch engine, from 1st April, 1840, to 1st of April, 1841.	* Cost of extraordinary repairs to each engine, from 1st April, 1840, to 1st of April, 1841.	Total cost of repairs to each engine from 1st of April, 1840, to 1st of April, 1841.	Cost of ordinary repairs to each engine, from commencemest of service, to 1st of April, 1841.	Total number of miles run by each engine, from commencement of service, to 1st of April, 1841.	Cost of extraordinary repairs to each engine, from commencement of service, to the 1st of April, 1841.	Total cost of repairs to each engine, from commencement of service to 1st of April, 1841.	REMARKS.
Georgia,	Baldwin, Vail and Hufty.	No. 3	May 5, '37.		a	968 06		968 06	2,073 58	29,380	96 00	2,169 58	Shop, undergoing repair.
Pennsylvania,		" 3	" " "	4,750	b	360 73		360 73	2,034 26	39,735		2,034 26	Road, good order.
Florida,		" 3	Dec 27, "	18,195	c	528 32	10 87	539 19	1,856 19	39,636	108 30	1,964 49	Honse, good order.
Alabama,		" 3	Jan 12, '38.	18,040	d	606 30	161 00	767 30	1,670 48	50,807	434 42	2,104 90	Shop, undergoing repair.
Louisiana,		" 3	Feb 2, "	13,005	e	1,074 22	146 25	1,220 47	2,516 10	52,602	359 87	2,875 47	Road, good order.
Tennessee,		" 3	M'y 29, "	12,495	f	706 87		706 87	1,396 48	39,289	193 98	1,590 46	House, complete order.
Wm. Dearing,		" 2	Nov 6, "	11,660	g	344 06		344 06	891 81	35,168	168 10	1,059 91	Road, good order.
Virginia,		" 2	Dec 24, "	9,930	h	801 11	55 00	856 11	1,402 95	31,470	316 19	1,719 14	House, complete order,
Mississippi,		" 2	" 28, "	3,800	i	271 50		271 50	565 46	15,137	473 56	1,039 02	House, good order.
Kentucky,		" 2	Mar 24, '39.	8,015	j	417 79		417 79	873 61	23,975	55 86	929 47	House, good order.
Wm. Cumming,		" 2	Dec 14, "	2,200	k	113 75		113 75	113 75	3,815	19 83	133 58	House, complete order.
James Camak,		" 2	" 23, "	3,450	l	226 36		226 36	226 36	5,475		226 36	Road, good order.
				110,540		6,419 07	373 12	6,792 19	15,621 03	366,489	2,225 61	17,846 64	

Extraordinary Repairs—Embraces the cost of repairing engines, damaged by accident.

Principal items of ordinary repairs, comprising the amounts stated in the fifth column.

a. A new set of copper flues, new iron frame and truck, cast iron braces to engine, etc.
b. New cast iron braces, $150, left out in original plan of engine, etc.
c. New Truck frame, new Tender frame, etc.
d. New set of springs, $45. New Truck frame and new wheels, $200.
e. New Truck, wheels and axles complete, $500; new crank axle, $200; new set of springs, $46 50
f. New Truck wheels and axles complete, $500. Boring cylinders, straightening crank axle, etc., etc.
g. New pair of wheels and axles for Tender, boring cylinders, etc.
h. New pair of driving wheels and axle complete, $701, etc.
i. New crank axle, $200, etc.—j. New Tender wheels, etc., etc.
k. & l. New work omitted or partially executed by the makers of the engine.

Condensed statement of the aggregate amount of business done on the Georgia Railroad, from April 1st, 1840 *to April 1st,* 1841.

	No. Passengers.	Amount.	Freight.	Mail.	Total.
April,	1,885½	$5,689 18	$7,098 55	$1,713 56	$14,501 29
May,	1,781½	5,101 75	5,084 81	1,713 56	11,900 12
June,	1,752½	5,033 40	2,391 58	1,713 56	9,138 54
July,	1,832	4,640 99	2,144 97	1,713 56	8,499 52
August,	1,816	4,514 88	2,327 71	1,713 56	8,556 15
September,	1,650	4,340 50	3,398 44	1,713 56	9,452 50
October,	2,165½	6,494 31	5,940 90	2,015 36	14,450 57
November,	1,844½	5,742 87	5,559 36	2,015 36	13,317 59
December,	2,396½	7,031 09	8,179 03	2,015 36	17,225 48
January,	1,981	5,751 08	6,901 28	2,015 36	14,667 72
February,	1,934½	5,895 18	7,848 57	2,015 36	15,759 11
March,	1,921	6,026 81	9,552 12	2,015 36	17,594 20
Total,	22,910½	66,262 04	66,427 32	22,373 52	155,062 88
Way passengers, Warrenton Branch,					48 75
Way passengers, Athens Branch,					83 36
Passengers by freight trains,					108 17
Extra trips,					383 56
Extra baggage and specie,					232 49
Freight between stations,					93 91
Premium on post office warrants,					1,275 57
Interest on freight notes,					936 42
					$158,225 11

Statement of expenses incurred for working the Georgia railroad, from April 1st, 1840, *to April 1st,* 1841.

TRANSPORTATION DEPARTMENT.

Stationery, Printing, etc.,	475 04	
Loss and damage,	738 67	
Incidentals,	883 45	
Oil and tallow for cars,	182 78	
Provisions, clothing, doctors bills, and other expenses of negroes,	2,593 98	
Expense of mules and pay of conductors Warrenton Branch,	799 43	
Wages of laborers,	2,355 11	
Agents and clerks,	7,356 39	
Conductors,	2,484 75	17,869 60

MAINTENANCE OF CARS.

Repairs, etc.,	4,735 20	
Car factory, lumber swept away and spoiled by freshet in 1840,	189 15	4,924 35

MOTIVE POWER.

Stationery, printing, etc.,	16 25	
Expense of water stations,	2,480 98	
Incidentals,	27 95	
Fuel,	5,402 87	
Oil, packing, etc., for engines,	1,177 54	
Ordinary and extraordinary repairs of engines,	6,792 19	
Engine and firemen,	4,715 13	
Provisions, clothing, doctors bills and other expenses of negroes,	2,039 97	22,652 88

MAINTENANCE OF WAY.

Mens wages,	12,103 67	
Provisions, clothing, doctors bill and other expenses of negroes,	1,592 35	
Incidentals,	180 49	
Tools,	377 56	
Wooden rails, cross-ties, etc.,	5,446 38	
Supervisors,	1,699 96	
Work done and materials furnished by car factory for repairs of road chiefly in consequence of freshets in May, 1840, and March, 1841,	436 20	—21,836 61
		$67,283 44

MEMOIRS OF SCIENTIFIC MEN.—THE TWO FOLLOWING MEMOIRS ARE FROM THE ADDRESS OF THE PRESIDENT DELIVERED AT THE LAST ANNIVERSARY MEETING OF THE ROYAL SOCIETY.—Simon Denis Poisson, one of the most illustrious men of science that Europe has produced, was born at Pithviers on the 21st of June, 1781, of very humble parentage, and was placed, at the age of fourteen, under the care of his uncle, M. L'Enfant, surgeon, at Fontainbleau, with a view to the study of his profession. It was at the central school of this place that he was introduced to the notice of M. Billy, a mathematician of some eminence, who speedily discovered and fostered his extraordinary capacity for mathematical studies. In 1793 he was elected a pupil of the Ecole Polytechnique, which was then at the summit of its reputation, counting among its professors, Laplace, Lagrange, Fourier, Monge, Prony, Berthollet, Fourcroy, Vanquelin, Guyton Morveau, and Chaptal. The progress which he made at this celebrated school surpassed the most sanguine expectations of his kind patron, M. Billy, and secured him the steady friendship and support of the most distinguished of his teachers. In the year 1800, he presented to the Institute a memoir, "Sur le nombro d'integrales completes dont les equations aux differences finies sont susceptibles," which cleared up a very difficult and obscure point of analysis. It was printed, on the recommendation of Laplace and Lagrange, in the *Memoires des Savans Etrangers*, an unexampled honor to be conferred on so young a man. Stimulated by its first success, we find him presenting a succession of memoirs to the Institute on the most important points of analysis, and rapidly assuming the rank of one of the first geometers of his age. He was successively made Repetiteur and then Professor of the Polytechnic School, Professor at the College de France and the Faculte des Sciences, member of the Bureau des Longitudes, and finally, in 1812, member of the Institute. His celebrated memoir on the *invariability* of the major axes of the planetary orbits, which received the emphatic approbation of Laplace, and secured him throughout his life, the zealous patronage of that great philosopher, was presented to the Institute in the year 1808. Laplace had shown that the periodicity of the changes of the other elements, such as the eccentricity and inclination, depends on the peirodicy of the changes of the major axis —a condition, therefore, which constitutes the true basis of the proof of the stability and permanence of the system of the universe. Lagrange had considered this great problem in the Berlin Memoirs for 1776, and had shown that, by neglecting certain quantities which might possibly modify the result, the expression for the major axis involved periodical inequalities only, and that they were consequently incapable of indefinite increase or diminution. It was reserved to Poisson to demonatrate *a priori* that the

non-periodic terms of the order which he considered would mutually destroy each other—a most important conclusion, which removed the principal objection that existed to the validity of the demonstration of Lagrange. This brilliant success of Poisson in one of the most difficult problems of physical astronomy, would appear to have influenced him devoting himself thenceforward almost exclusively to the application of mathematics to physical science; and the vast number of memoirs and works (amounting to more than 300 in number,) which he published during the last thirty years of his life, made this department of mathematical science, and more particularly whatever related to the action of molecular forces, pre-eminently his own. They comprehend the theory of waves and of the vibrations of elastic substrnces, the laws of the distribution of electricity and magnetism, the propogation of heat, the theory of capillary attraction, the attraction of spheroids, the local magnetic attraction of *ships*, important problems on chance and a multitude of other subbjects. His well known treatise on mechanics is incomparably superior to every similar publication in the clear and decided exposition of principles and methods, and in the happy, luminous combination of the most general theories with their particular and most instructive applications. Poisson was not a philosopher who courted the credit of propounding original views which did not arise naturally out of the immediate subjects of his researches; and he was more disposed to extend and perfect the application of known methods of analysis to important physical problems, than to indulge in speculation on the invention or transformation of formulæ, which, however new and elegant, appeared to give him no obvious increase of mathematical power in the prosecution of his inquiries. His delight was to grapple with difficulties which had embarrassed the greatest of his predecessors, and to bring to bear upon those vast resources of analysis and those clear views of mechanical and physical principles in their most refined and difficult applications, which have secured him the most brilliant triumphs in nearly every department of physical science. The confidence which he was accustomed to feel in the results of his analysis—the natural result of his own clear perception of the necessary dependence of the several steps by which they were deduced—led him sometimes to accept conclusions of a somewhat startling character; such were his views of the constitution and finite extent of the earth's atmosphere, which some distinguished philosophers have ventured to defend. It is not in mathematical reasonings only that we are sometimes disposed to forget that the conclusions which we make general are not dependent upon our assumed premises alone, but are modified by concurrent or collateral causes, which neither our analysis nor our reasonings are competent to comprehend. The habits of life of this great mathematician were of the most simple and laborious kind; though he never missed a meeting of the Institute, or a lecture, or an examination, or any other public engagement, yet on all other occasions, at least in later years, he denied access to all visitors, and remained in his study from an early hour in the morning until six o'clock at night, when he joined his family at dinner, and spent the evening in social converse, or in amusements of the lightest and least absorbing character, carefully avoiding every topic which might recall the severity of his morning occupations. The wera and tear, however, of a life devoted to such constant study, and the total neglect of exercise and healthy recreations, finally undermined his naturally vigorous constitution, and in the autumn of 1838 the alarming discovery was made that he was laboring under the fatal disease of water in the chest. The efforts of his physician contributed for a long time to mitigate the more serious symptoms of his malady; but every relaxation of his

sufferings led to the resumption of his labors; and to the earnest remonstrances of his friends, and the entreaties of his family, he was accustomed to reply, that to him *la vie c'etait le travail;* nay, he even undertook to conduct the usual examinations of the Ecole Polytechnique, which occupied him for nearly ten hours a day for the greatest part of a month. This last imprudent effort ended in an attack of paralysis, attended by loss of memory and the rapid obscuration of all his faculties; he continued to struggle, amidst alternations of hope and despondency, for a considerable period, and died on the 25th of April last, in the 59th year of his age. Poisson was eminently a deductive philosopher, and one of the most illustrious of his class; his profound knowledge of the labors of his predecessors, his perfect command of analysis, and his extraordinary sagacity and tact in applying it, his clearness and precision in the enunciation of his problems, and the general eleganae of form which pervaded his investigations, must long continue to give to his works that classical character, which has hitherto been almost exclusively appropriated to the productions of Lagrange, Laplaee, and Euler. If he was inferior to Fourier or to Fresnel in the largeness and pregnancy of his philosophical views, he was incomparably superior to them in mathematical power; if some of his contemporaries rivalled or surpassed him in particular departments of his own favorite studies, he has left no one to equal him, either in France or in Europe at large, in the extent, variety, and intrinsic value of his labors. The last work on which he was engaged was a treatise on the theory of light, with particular reference to the recent researches of Cauchy; nearly two hundred prges of this work are printed, which are altogether confined to generalities, whose applications were destined to form the subject of a second and concluding section: those who are acquainted with the other works of Poisson will be best able to appreciate the irreparable loss which optical science has sustained in the non-completion of such a work from the hands of such a master.

RICHARDSON'S ACCELERATED STEAMBOAT.—We have before us a drawing and description of a new kind of steamboat, invented by Col. J. S. Richardson. Its leading peculiarity is that by means of a huge balloon, or gas, holder, shaped like a cucumber, and extended lengthwise over the boat (or rather boats, for there are two hulls connected by a deck and saloon above,) the latter is raised out of the water, except the keels and paddles or the water wheels, thus reducing the resistance of the water to almost nothing and yet using it for the purposes of propulsion and steering. The plan is ingenious, but how it will succeed in practice, we shall know better when the experiment is made. Col. Richardson and his associates have announced their intention to build and put in operation, one of these boats on the north river. The balloon is to be made of duck and divided into sections so that in being perforated by a vessel's boom, or other cause, only a small part of the gas would escape. Supposing the plan to operate in practice as it presents itself in theory, a rate of speed, would be attained that would distance all other, traveling expedients. It is easy enough to see, that with steam power applied to the water as in other steamboats, and with little resistance from the water, the boat must go ahead with astonishing rapidity.—*Jour. Com.*

Discovery of Tin Ore.—Extract of a letter, dated Walpole, N. H., 15 June:—Dr. Jackson, the State geologist, states the certain existence of tin ore on the eastern slope of the White Mountains, in the town of Jackson, county of Coos, N. H. Dr. Jackson appears to be of the opinion that the ore will prove to be abundant—if so, this is the first discovery of tin in quantity in the United States.